

# TRIPURA GAZETTE

*Published by Authority*  
**EXTRAORDINARY ISSUE**

---

*Agartala, Tuesday, November 15, 2022 A. D., Kartika 24, 1944 S. E.*

---

**PART--I-- Orders and Notifications by the Government of Tripura,  
The High Court, Government Treasury etc.**

**GOVERNMENT OF TRIPURA  
PUBLIC WORKS DEPARTMENT**

No.F.6(14)-PWD(E)2022/13642-91

Dated, Agartala, 27th October, 2022.

## **NOTIFICATION**

In exercise of the powers conferred by the provisions to article 309 of the Constitution of India and all other powers enabling him in this behalf, the Governor, Tripura is pleased to make the following Rules in connection with syllabus, mode of examination and selection of direct recruitment of Engineers to different Departments of the Government namely:

### **1. Short title and commencement**

i) These Rules may be called "**Combined Competitive Examination Rules, 2022**" for direct recruitment of Engineers to different Departments of the Government such as PWD, Agriculture, ARDD, Education, Food and Civil Supplies & Consumer Affairs, Rural Development, Science & Technology, Police (Home), ST Welfare, Fisheries Departments and such other Departments as may be notified by the Government from time to time.

ii) They shall come into force on the date of their publication in the Official Gazette.

iii) All the Departments concerned will be required to submit requisitions to the PWD which will work as Nodal Department for the purpose. And thereafter, the PWD will compile the said requisitions and submit materials to the TPSC twice in a year in the month of January and June as per requisition received from those Departments.

### **2. Definition**

In these rules, unless the context otherwise requires:

a). 'Commission' means the Tripura Public Service Commission

b) 'Rules' means Tripura Engineering Service Rules (7<sup>th</sup> Amendment), 2014

c) 'Service' means Tripura Engineering Service.

d) 'Department' means PWD, Agriculture, ARDD, Education, Food and Civil Supplies & Consumer Affairs, Rural Development, Science & Technology, Police (Home), ST Welfare, Fisheries and such other Departments as notified by the Government from time to time.

e) 'Government' means the Government of Tripura.

### **3. Competitive examination for direct recruitment**

(i) As provided in Part —IV of the Service, selection of candidates for direct recruitment to the service and other equivalent posts under various departments shall be made by the Commission on the basis of a common competitive examination to be conducted by it.

(ii) Every year, preferably in the month of January, the Public Works Department (PWD) being the nodal Department will send requisition to the Commission after receipt of requirement from the departments of

---

the State Government. Having regard to the number of vacancies mentioned in the requisition, the Commission shall conduct a combined competitive examination for direct recruitment. The Commission will complete the process of selection of the candidates through the examination ordinarily within a period of 1 year and recommend to the PWD a list of selected candidates according to merit.

(iii) Before holding the examination, the Commission shall issue an advertisement notifying, inter alia, the Department wise vacancies with the breakup of the posts earmarked for the unreserved and reserved category of candidates and inviting applications from the candidates with their choice of Departments willing to appear in the examination. The advertisement shall also indicate that the number of vacancies so notified may increase or decrease according to necessity.

(iv) In case a communication is received by the Commission from the employer of a candidate withholding permission to appear at the examination, his application shall be rejected/ candidature shall be cancelled by the Commission;

Provided that a candidate who gets appointment to any post after submission of his application for admission to the examination must furnish forthwith evidence to show that his employer has no objection to his being selected for a post on the results of the examination. **Further the candidates are instructed to follow the advertisement scrupulously.**

#### **4. Preference**

(i) After publication of result of preliminary examination a candidate should clearly indicate in his /her application the Department for which he/she wishes to be considered in order of preference as per format of TPSC. No request for alteration in the preference indicated by a candidate in his/her application shall be entertained.

(ii) Selection of candidates will be made in order of merit and according to the number of vacancies available. Due consideration will be given, as far as practicable, to the preferences indicated by a candidate, if any, but the commission reserves the right to allot the candidate to any department or post for which he/she is a candidate on consideration of his/her candidature who has paid application fees as prescribed and fulfilled the terms of advertisement will receive an Admit Card and a time table for the examination. The admission will be deemed to be provisional subject to determination of his eligibility in all respects; fitness and number vacancies available.

#### **5. Eligibility**

Eligibility of candidates shall be determined as per relevant recruitment rules of the respective Departments.

#### **6. Application form, application fees and booklets containing syllabus**

(i) Application forms will be filled up online and required fees are to be paid online or in the manner as prescribed by the Commission.

(ii) Syllabus will be available in the Commission's & PWD's website after publication of advertisement.

(iii) Documents, Papers etc. to be attached with the application form and its mode of submission to the Commission shall be clearly notified by the Commission at the time of advertisement.

#### **7. Admission Certificate**

(i) A candidate who has paid application fees as prescribed and fulfilled the terms of advertisement will receive an Admission Certificate and a time table for the examination or as instructed by Commission. The admission will be deemed to be provisional subject to determination of his eligibility in all respects;

(ii) No candidate shall be admitted to the examination unless he holds an Admission Certificate. If at any stage after issue of the Admission Certificate, a candidate is found to be ineligible for admission in terms of the regulations of the examination; his candidature shall be cancelled without further reference to him.

**8. Consequences of violation of rules, regulations, instructions etc.**

A candidate who violates the rules, regulations and instructions issued by the Commission, Supervisor or Invigilator on duty in the Examination Hall, be liable to expulsion from the Examination Hall and/or other penalties as provided in the regulations of the Commission.

9. Matters for which no specific provision has been made in the regulations shall be decided by the Commission.

**PART-I**

**10. Nature and syllabus of the examination**

The examination shall have the following three parts namely:

- (i) **Preliminary Examination** (MCQ type) carrying 100 marks. The Preliminary Examination is meant to serve as a screening test only for the purpose of selection of candidates for the Main Examination. The marks obtained in this examination by the candidates will not be considered for final selection. A limited number of candidates, maximum 05 (five) times of total posts (category wise) will be selected merit wise on the basis of the result of Preliminary Examination, subject to securing minimum qualifying marks (40% for UR & 30% for reserved category candidates). Only those candidates who will be declared qualified at the Preliminary Examination will be eligible for admission to the Main Examination.
- (ii) **Main (Written) Examination** carrying 500 marks. The minimum cut off marks to qualify in Main Examination is 40% in aggregate for UR & 30% in aggregate for Reserved Category Candidates. The selected candidates on the basis of results of the Main (Written) Examination will be allowed to appear in the Interview Cum Personality Test as per ratio given in Para 12(iii) .
- (iii) **An Interview-cum-personality Test** carrying 50 marks.

**11. Written part of the examination**

**Preliminary Examination:** The preliminary Examination will consist of only one paper viz. a paper on “General Studies & Engineering Aptitude”. The paper will be of an Objective Type consisting of 100 Multiple Choice questions. The paper will carry 100 Marks and will be of 2 (two) hours duration.

The paper will include questions covering the following field of knowledge:

i) English Composition	-	10 marks
ii) General Knowledge & Current events of Local, National & International Importance	-	10 marks
iii) Engineering Aptitude (in related branch)	-	80 marks
<b>Total</b>	-	<b>100 marks</b>

**Negative marking will be as per TPSC norms.**

**Main Examination**

**Compulsory**

a) General Studies	100 Marks	1 hour duration
--------------------	-----------	-----------------

**Optional** (Any two of the following papers in the appropriate branch of engineering)

200 marks in each paper	3 hours duration
-------------------------	------------------

- a) Civil Engineering paper -I
- b) Civil Engineering paper – II

- c) Mechanical Engineering paper -I
- d) Mechanical Engineering paper -II
- e) Electrical Engineering paper -I
- f) Electrical Engineering Paper -II

(ii). As shown in the above table General Studies is compulsory for candidates of all Grades of the Service i.e. Grade-IV, Grade-V(A) and Grade-V(B) and respective equivalent posts of other departments. Civil Engineering papers are compulsory for candidates who apply for posts in Civil Engineering Branch, Mechanical Engineering papers are compulsory for candidates who apply for posts in Mechanical Engineering Branch and Electrical Engineering papers are compulsory for candidates who apply for posts in Electrical Engineering Branch. Similar restriction shall apply to all similar ranking posts.

(iii). Detailed syllabus and group-wise break up of marks for each of the above-mentioned subjects/papers for Grade-IV, Grade-V(A) and Grade-V(B) and respective equivalent posts of other departments have been given in **Schedule-I, Schedule-II & Schedule-III, Schedule-I, Schedule-II & Schedule-IV and Schedule-I, Schedule-II & Schedule-V** respectively to these Rules.

(iv). Qualifying marks for unreserved category shall be minimum 40% **in aggregate** and that of reserve category shall be minimum 30% **in aggregate**.

(v). In exceptional circumstances categories the Commission, at its discretion, shall fix the minimum qualifying marks for a paper and the minimum qualifying aggregate marks for all the papers otherwise; Provided that in case a candidate fails to secure the qualifying marks, so fixed in any paper compulsory or optional, marks in that paper shall not be considered for calculating the aggregate.

(vi). Questions in all the papers shall be answered only in English and in no other language.

## **12. Interview-cum-personality test**

(i). The Commission shall conduct an Interview-cum-personality test of those candidates, who have obtained qualifying marks in the written part of the examination. The pattern of the Interview-cum-personality test shall be decided by the Commission in accordance with the requirement of the service and the post for which the examination is conducted.

(ii). The personality test shall be to assess the personal qualities of a candidate e.g., his intellectual ability, social traits, interest in current affairs, critical power of judgment, variety and depth of interest, ability for leadership, moral integrity etc.

(iii). In no case shall a candidate be called for personality test unless he appears in all the papers of the examination.

**Ratio for calling of Candidates for Interview-Cum- Personality Test provided he/she secured minimum cut off marks in the Main exam:**

No of vacancies	No of candidates to be called for Personality Test/ Interview (Category wise)
1(one)	5(five) candidates
2(two)	8(eight) candidates
3(three)	3(three) times the number of vacancies.

## **13. Final Selection and validity of the Select List**

(i). Final selection shall be made in order of merit on the basis of the marks obtained by a candidate in aggregate in the written examination and the marks obtained by him in the personality test and following other norms of the TPSC in this regard. If a candidate remains absent in the personality test, his candidature shall not be considered for final selection.

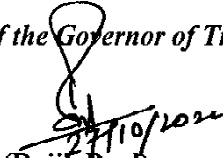
(ii). The Select List recommended by the Commission shall remain valid for a period of 6 months from the date of recommendation and in no case for more than a period of one year, if so extended by the Government in consultation with the Commission.

**14. Repeal & Savings:**

(i) The Combined Competitive Examination Rules, 2009 for direct recruitment of Engineers to different Departments of the Government such as PWD, Agriculture, ARDD, Education, Food and Civil Supplies & Consumer Affairs, Rural Development, Science & Technology, Police (Home), ST Welfare, Fisheries Departments and such other Departments are hereby repealed.

(ii) Notwithstanding such repeal any action taken or anything whatsoever done under the rules so repealed shall be deemed to have been taken or done under the corresponding provisions of these Rules.

*By order of the Governor of Tripura,*

  
(Rajib Paul)

Deputy Secretary  
Public Works Department

**SCHEDULE — I**  
**COMPULSORY FOR ALL GRADE/POSTS/BRANCHES**

**Preliminary Examination\*:** The paper will carry 100 Marks (MCQ Type) and will be of 2 (two) hours duration.

The paper will include questions covering the following field of knowledge:

i) English Composition	-	10 marks
ii) General Knowledge & Current events of Local, National & International Importance	-	10 marks
iii) Engineering Aptitude (in related branch)	-	80 marks
<b>Total</b>	-	<b>100 marks</b>

Negative marking will be as per TPSC norms.

<b>SCHEDULE — II</b>	
<b>Clause No</b>	<b>Description</b>
<b>I</b>	<b>GENERAL STUDIES (COMPULSORY FOR ALL GRADE/POSTS/BRANCHES)</b>
	<b>TOTAL MARKS — 100</b>
	<b>Duration of examination — 1 hour</b>
	<b>The break up of marks on various topics will be as follows:-</b>
<b>Topic</b>	<b>Marks</b>
i) Comprehension of a given passage	20
ii) Usage (corrections)	10
iii) Vocabulary (synonyms & antonyms, idioms & phrases)	10
iv) General knowledge (Questions will include knowledge of Indian and geography of such a nature which the candidates should be able to answer without any special study. Questions on Tripura, its historian topography will also be included.)	20
v) Current Affairs (The questions will include knowledge of Indian current events and of such matters of every day observation and experience in their scientific aspects as may be expected of an educated person who has not made a special study of any scientific subject.)	20
vi) Mental Ability.	20
<b>Total</b>	<b>100</b>
<b>II.</b>	<b>ENGINEERINGS SUBJECT PAPER - I &amp; II(OPTIONAL FOR ALL GRADES / BRANCHES)</b>
	<b>TOTAL MARKS — 200 (each paper)</b>
	<b>Duration of examination —3 hours</b>
	<b>The break up of marks will be as follows:</b>
<b>Topic</b>	<b>Marks</b>
i) 15 questions of 6 marks each having answers restricted to 40 words.	90
ii) 40 multiple choice type questions of 2 marks each	80
iii) 05 numerical questions of 6 marks each	30
<b>Total</b>	<b>200</b>

**SCHEDULE-III**

**Syllabus for Grade IV/ Assistant Engineer  
CIVIL ENGINEERING  
PAPER -I**

**Total Marks — 200**

**Duration of Examination — 3 Hours**

**1. BUILDING MATERIALS**

**Timber:** Different types and species of structural timber, density-moisture relationship, strength in different directions, defects, influence of defects on permissible stress, preservation, dry and wet rots codal provisions for design, Plywood.

**Bricks:** Types, Indian Standard classification, absorption, saturation factor, strength in masonry, influence of mortar strength on masonry strength.

**Cement:** Compounds of different types, setting times, strength.

**Cement Mortar:** Ingredients, proportions, water demand, mortars for plastering and masonry.

**Concrete:** Importance of W/C Ratio, Strength, ingredients including admixtures, workability, testing for strength, elasticity, non-destructive testing, mix design methods.

**2. SOLID MECHANICS**

Elastic constants, stress, plane stress, Mohr's circle of stress, strains, plane strain, Mohr's circle of strain, combined stress; Elastic theories of failure; Simple bending, shear; Torsion of circular and rectangular sections and simple members.

**3. DESIGN OF STEEL STRUCTURES**

Principles of working stress method. Design of connections, simple members, Built-up sections and frames, Design of Industrial roofs. Principles of ultimate load design. Design of simple members and frames.

**4. DESIGN OF CONCRETE AND MASONRY STRUCTURES**

Limit state design for bending, shear, axial compression and combined forces. Codal provisions for slabs, beams, walls and footings. Working stress method of design of R.C members.

Principles of prestressed concrete design, materials, methods of pre stressing, losses. Design of simple members and determinate structures. Introductions to prestressing of indeterminate structures.

Design of brick masonry as per I.S. Codes.

**5. CONSTRUCTION PRACTICES, PLANNING AND MANAGEMENT**

**Concreting Equipment:** Weight Batcher, Mixer, vibrator, batching plant, concrete pump. Cranes, hoists, lifting equipment.

**Earthwork Equipment:** Power shovel, hoe, dozer, dumper, trailers and tractor, rollers, sheep foot rollers, pumps.

**Construction, Planning and Management:** Bar chart, linked bar chart, work-break down structures, Activity-on - arrow diagrams. Critical path, probabilistic activity durations; Event-based networks.

**PERT network:** Time-cost study, crashing; Resource allocation



**CIVIL ENGINEERING  
PAPER - II**

**Total Marks - 200  
Duration of Examination - 3 Hours**

**1(a) FLUID MECHANICS, OPEN CHANNEL FLOW PIPE FLOW:**

Fluid Properties, Pressure, Thrust, Buoyancy; Flow Kinematics; Integration of flow equations; Flow measurement; Relative motion; Moment of momentum; Viscosity, Boundary layer and Control, Drag, Lift; dimensional Analysis, Modeling; Cavitation; Flow oscillations; Momentum and Energy principles in Open channel flow, Flow controls, Hydraulic jump, Flow sections and properties; Normal flow, Gradually varied flow; Surges; Flow development and losses in pipe flows, Measurements; Siphons; Surges and Water hammer; Delivery of Power Pipe networks.

**(b) HYDRAULIC MACHINES AND HYDROPOWER:**

Centrifugal pumps, types, performance parameters, scaling, pumps in parallel; Reciprocating pumps, air vessels, performance parameters; Hydraulic ram; Hydraulic turbines, types, performance parameters, controls, choice; Power house, classification and layout, storage, pondage, control of supply.

**2(a) HYDROLOGY:**

Hydrological cycle, precipitation and related data analyses, PMP, unit and synthetic hydrographs; Evaporation and transpiration; Floods and their management, PMF; Streams and their gauging; River morphology; Routing of floods; Capacity of Reservoirs.

**(b) WATER RESOURCES ENGINEERING:**

Multipurpose uses of Water: Soil-Plant-Water relationships, irrigation systems, water demand assessment; Storages and their yields, ground water yield and well hydraulics; Water logging, drainage design; Irrigation revenue; Design of rigid boundary canals, lining of canals; Sediment transport in canals; Non-Overflow and overflow sections of gravity dams and their design, Energy dissipaters and tail water rating; Design of head works, distribution works, falls, cross-drainage works, outlets; River training.

**3. ENVIRONMENTAL ENGINEERING**

**(a) WATER SUPPLY ENGINEERING:**

Sources of supply, yields, design of intakes and conductors; Estimation of demand; Water quality standards; Control of Water-borne diseases; Primary and secondary treatment, detailing and maintenance of treatment units; Conveyance and distribution systems of treated water, leakages and control; Rural water supply; Institutional and industrial water supply.

**(b) WASTE WATER ENGINEERING:**

Urban rain water disposal; Systems of sewage collection and disposal; Design of sewers and sewerage systems; pumping; Characteristics of sewage and its treatment, Disposal of products of sewage treatment, stream flow. Plumbing Systems, Rural and semi-urban sanitation.

•1

**(c) SOLID WASTE MANAGEMENT:**

Sources, classification, collection and disposal; Design and Management of landfills

**4. (a) SOIL MECHANICS:**

Properties of soils, classification and interrelationship; Compaction behavior, methods of compaction and their choice; Permeability and seepage, flow nets, Inverted filters; Compressibility and consolidation; Shearing resistance, stresses and failure; soil testing in laboratory and in-situ; Stress path and applications; Earth pressure theories, stress distribution in soil; soil exploration, samplers, load tests, penetration tests.

**(b) FOUNDATION ENGINEERING:**

Types of foundations, Selection criteria, bearing capacity, settlement, laboratory and field tests; Types of piles and their design and layout, Foundations on expansive soils, swelling and its prevention, foundation on swelling soils.

**5. (a) SURVEYING :**

Classification of surveys, scales, accuracy; Measurement of distances -direct and indirect methods; optical and electronic devices; Measurement of directions, prismatic compass, local attraction; Theodolites - types; Measurement of elevations - Spirit and trigonometric leveling; Relief representation; Contours; Digital elevation modeling concept; Establishment of control by triangulations and traversing - measurements and adjustment of observations, computation of coordinates; Field astronomy, Concept of global positioning system; Map preparation by plane tabling and by photogrammetry; Remote sensing concepts, map substitutes.

**(b) TRANSPORTATION ENGINEERING:**

Planning of highway systems, alignment and geometric design, horizontal and vertical curves, grade separation; Materials and construction methods for different surfaces and maintenance; Principles of pavement design; Drainage.

Traffic surveys, Intersections, signaling; Mass transit systems, accessibility, networking.

**MECHANICAL ENGINEERING  
PAPER—I**

**Total Marks - 200  
Duration of Examination — 3 Hours**

**1. STRENGTH OF MATERIALS:**

Stress and strain in two dimensions, Principal stresses and strains, Mohr's construction, linear elastic materials, isotropy and anisotropy, stress-strain relations, uniaxial loading, thermal stresses. Beams: Bending moment and shear force diagram, bending stresses and deflection of beams. Shear stress distribution.

Torsion of shafts, helical springs. Combined stresses, thick-and thin-walled pressure vessels. Struts and columns. Strain energy concepts and theories of failure.

**2. FLUID MECHANICS.**

Properties and classification of fluids, Manometer, forces on immersed surfaces, Center of pressure, Buoyancy, Elements of stability of floating bodies. Kinematics and Dynamics. Irrotational and incompressible. Inviscid flow. Velocity potential, Pressure field and Forces on immersed bodies. Bernoulli's equation, fully developed flow through pipes,

Pressure drop calculations, Measurement of flow rate and Pressure drop. Integral approach, Laminar and turbulent flows, Separations. Flow over weirs and notches. Open channel flow, Hydraulic jump. Dimensionless numbers, Similitude and modelling. One-dimensional isentropic flow, Normal shock wave, Flow through convergent - divergent ducts, Oblique shock-wave.

**3. THEORY OF MACHINES:**

Cams. Gears and gear trains. Flywheels. Governors. Balancing of rigid rotors and field balancing. Balancing of single and multicylinder engines. Critical speeds and whirling of shafts Automatic controls.

**4. MACHINE DESIGN :**

**Design of Joints:** Cotters, keys, Splines, Welded joints, Threaded fasteners, joints formed by interference fits. Design of friction drives: couplings and clutches, belt and chain drives, power screws.

**Design of Power transmission Systems:** gears and gear drives shaft and axle, wire ropes.

**Design of Bearings:** hydrodynamics bearings and rolling element bearings.

**5. FLUID MACHINERY AND STEAM GENERATORS:**

Performance, Operation and control of hydraulic Pump, impulse and reaction Turbines, Specific speed, Classification. Energy transfer, Coupling, Power transmission, Steam generators, Fire-tube and water-tube boilers. Flow of steam through Nozzles and Diffusers, Wetness and condensation. Various types of steam and gas Turbines. Partial admission. Reciprocating, Centrifugal and axial flow Compressors, Multistage compression, role of Mach number, Reheat, Regeneration, Efficiency, Governance.

**MECHANICAL ENGINEERING**

**PAPER—II**

**Total Marks —200**

**Duration of Examination — 3 Hours**

**1. THERMODYNAMICS:**

Cycles and IC Engines, Basic concepts, Open and Closed systems. Heat and work. Zeroth, First and Second Law, Application to non-Flow and Flow processes. Entropy, Availability. Properties of ideal gases and vapours. Standard vapour, Gas power and Refrigeration cycles. Two stage compressor. C-I and S.I. Engines. Pre-ignition, Detonation and Diesel-knock, Fuel injection and Carburetion, Supercharging. Turbo-prop and Rocket engines, Engine Cooling, Emission & Control. Measurement of Calorific values. Conventional and Nuclear fuels, Elements of Nuclear power production.

**2. HEAT TRANSFER, REFRIGERATION AND AIR-CONDITIONING:**

Modes of heat transfer. One dimensional steady and unsteady conduction. Composite slab and Equivalent Resistance. Heat dissipation from extended surfaces, Heat exchangers, Overall heat transfer coefficient, Empirical correlations for heat transfer in laminar and turbulent flows and for free and forced Convection, Thermal boundary layer over a flat plate. Fundamentals of diffusive and convective mass transfer, Black body and basic concepts in Radiation, Enclosure theory, Shape factor. Heat pump and Refrigeration cycles and systems, Refrigerants.

Condensers, Evaporates and Expansion devices, Psychrometry, Charts and application to air conditioning, Sensible heating and cooling, Effective temperature, comfort indices, Load calculations, Solar refrigeration, controls, Duct design.

**3. ENGINEERING MATERIALS:**

Basic concepts on structure of solids. Crystalline materials. Defects in crystalline materials, Alloys and binary phase diagrams. Structure and properties of common engineering materials. Heat treatment of Steels. Plastics, Ceramics and composite materials. Common applications of various materials.

**4. INDUSTRIAL ENGINEERING:**

**Production Planning and Control:** Forecasting - Moving average, exponential smoothing, Operations, scheduling; assembly line balancing, Product development, Break-even analysis, Capacity planning, PERT and CPM.,

**Control Operations:** Inventory control ABC analysis, EOQ model, Materials requirement planning. Job design, Job standards, Work measurement, Quality Management - Quality analysis and control.

**Operations Research:** Linear Programming - Graphical and Simplex methods, Transportation and assignment models.

**Value Engineering:** Value analysis for cost/value,

**ELECTRICAL ENGINEERING  
PAPER— I**

**Total Marks — 200  
Duration of Examination — 3 Hours**

**1. EM THEORY:**

Electric and magnetic fields. Gauss's Law and Amperes Law. Fields in dielectrics, conductors and magnetic materials. Time varying fields. Plane-Wave propagating in dielectric and conducting media. Transmission lines.

**2. ELECTRICAL MATERIALS:**

Conductors, Semi-conductors and Insulators. Super-conductivity. Insulators for electrical and electronic applications. Magnetic materials. Ferro and ferri magnetism. Ceramics, Properties and applications. Hall effect and its applications, Special semi conductors.

**3 ELECTRICAL CIRCUITS**

Circuits elements. Kirchhoff's Laws. Mesh and nodal analysis. Network Theorems and applications. Natural response and forced response. Transient response and steady state response for arbitrary inputs. Properties of networks in terms of poles and zeros. Transfer function. Resonant circuits. Three phase circuits. Two-port networks. Elements of two-element network synthesis.

**4. MEASUREMENTS AND INSTRUMENTATION**

Units and Standards. Measurement of current, Voltage, power, Power-factor and energy. Indicating instruments. Measurement of resistance, inductance, Capacitance and frequency. Bridge measurements. Electronic measuring instruments. Digital Voltmeter and frequency counter. Transducers and their applications to the measurement of non-electrical quantities like temperature, pressure, flow-rate

displacement, acceleration, noise level etc. Data acquisition systems. A/D and D/A converters.

### **5. CONTROL SYSTEMS.**

Block diagrams and signal flow graphs and their reduction. Errors for different type of inputs and stability criteria for feedback systems. Stability analysis using Routh-Hurwitz array, Nyquist plot and Bode plot. Root locus and Nicols chart and the estimation of gain and phase margin. Basic concepts of compensator design. State variable matrix and its use in system modelling and design. Sampled data system and performance of such a system with the samples in the error channel. Stability of sampled data system. Elements of non-linear control analysis. Control system components, electromechanical, hydraulic, pneumatic components.

## **ELECTRICAL ENGINEERING PAPER — II**

**Total Marks - 200  
Duration of Examination — 3 Hours**

### **1. ELECTRICAL MACHINES AND POWER TRANSFORMERS.**

Magnetic Circuits. Construction and testing. Equivalent circuits. Losses and efficiency. Regulation. Auto-transformer, 3-phase transformer. Parallel operation. Basic concepts in rotating machines. EMF, torque, basic machine types. Construction and operation, leakage losses and efficiency.

B.C. Machines. Construction, Excitation methods. Circuit models. Armature reaction and commutation. Generators and motors. Starting and speed control. Testing, Losses and efficiency.

Synchronous Machines. Construction. Circuit model. Operating characteristics. Synchronous reactance. Efficiency. Voltage regulation. Salient-pole machine, Parallel operation. Hunting. Short circuit transients.

Induction Machines. Construction. Principle of operation. Rotating fields. Characteristics and performance analysis. Determination of circuit model. Circle diagram. Starting and speed control. Fractional KW motors. Single-phase synchronous and induction motors.

### **2. POWER SYSTEMS**

Types of Power Stations, Hydro, Thermal and Nuclear Stations. Pumped storage plants. Economics and operating factors. Power transmission.

Lines. Modeling and performance characteristics. Voltage control—Load flow studies. Optimal power systems operation. Load frequency control. Symmetrical Components. Per Unit representation. Fault analysis. Transient and steady-state stability of power systems. Equal area criterion. Power system Transients. Power system Protection Circuit breakers. Relays. HVDC transmission.

### **3. ANALOG AND DIGITAL ELECTRONICS AND CIRCUITS**

Semiconductor device physics, PN junctions and transistors, circuit models and parameters, FET, Zener, tunnel, Schottky, photo diodes and their applications, rectifier circuits, voltage regulators and multipliers, switching behavior of diodes and transistors. Small signal amplifiers, biasing circuits, frequency response and improvement, multistage amplifiers and feed-back amplifiers, D.C. amplifiers, Oscillators. Large signal amplifiers, coupling methods, push pull amplifiers, operational amplifiers, wave shaping circuits. Multivibrators and flip-flops and their applications. Digital logic

gate families, universal gates-combination circuits for arithmetic and logic operational, sequential logic circuits. Counters, registers, RAM and ROMs.

#### **4. MICROPROCESSORS**

Microprocessor architecture-Instruction set and simple assembly language programming. Interfacing for memory and I/O. Applications of Microprocessors in power system.

#### **5. COMMUNICATION SYSTEMS**

Types of modulation; AM, FM and PM. Demodulators. Noise and bandwidth considerations. Digital communication systems. Pulse code modulation and demodulation. Elements of sound and vision broadcasting. Carrier communication. Frequency division and time division multiplexing, Telemetry system in power engineering.

#### **6. POWER ELECTRONICS**

Power Semiconductor devices. Thyristor. Power transistor, GTOs and MOSFETS. Characteristics and operation. AC to DC Converters; 1-phase and 3-phase DC to DC Converters; AC regulators. Thyristor controlled reactors; switched capacitor networks. Inverters; single-phase and 3-phase. Pulse width modulation. Sinusoidal modulation with uniform sampling. Switched mode power supplies.

### **SCHEDULE – IV**

#### **Syllabus for Grade V (A)/Junior Engineer (Degree holder)**

#### **CIVIL ENGINEERING PAPER — I**

**Total Marks — 200**

**Duration of Examination — 3 Hours**

#### **1. BUILDING MATERIALS**

**Timber:** Different types and species of structural timber, density-moisture relationship, strength in different directions, defects, influence of defects on permissible stress, preservation, dry and wet rots, codal provisions for design, Plywood.

**Bricks:** Types, Indian Standard classification, absorption, saturation factor, strength in masonry, influence of mortar strength on masonry strength.

**Cement:** Compounds of different types, setting times, strength.

**Cement Mortar:** Ingredients, proportions, water demand, mortars for plastering and masonry.

**Concrete:** Importance of W/C Ratio, Strength, ingredients including admixtures, workability, testing for strength, elasticity, non-destructive testing, mix design methods

#### **2. SOLID MECHANICS:**

Elastic constants, stress, plane stress, Mohr's circle of stress, strains, plane strain, Mohr's circle of strain, combined stress; Elastic theories of failure; Simple bending, shear; Torsion of circular and rectangular sections and simple members.

#### **3. DESIGN OF STEEL STRUCTURES:**

Principles of working stress method. Design of connections, simple members, Built-up sections and frames, Design of Industrial roofs. Principles of ultimate load design.

**4. DESIGN OF CONCRETE AND MASONRY STRUCTURES:**

Limit state design for bending, shear, axial compression and combined forces. Codal provisions for slabs, beams, walls and footings. Working stress method of design of R.C. members.

Principles of prestressed concrete design, materials, methods of prestressing, losses. Design of simple members and determinate structures.

**5. CONSTRUCTION PRACTICES, PLANNING AND MANAGEMENT:**

**Concreting Equipment:** Weight Batcher, Mixer, vibrator, batching plant, concrete pump. Cranes, hoists, lifting equipment.

**Earthwork Equipment:** Power shovel, hoe, dozer, dumper, trailers and tractor, rollers, sheep foot rollers, pumps.

**Construction, Planning and Management:** Bar chart, linked bar chart, work-break down structures, Activity - on - arrow diagrams. Critical path, probabilistic activity durations; Event-based networks.

**CIVIL ENGINEERING**

**PAPER — II**

**Total Marks - 200**

**Duration of Examination - 3 Hours**

**1. (a) FLUID MECHANICS, OPEN CHANNEL FLOW, PIPE FLOW:**

Fluid Properties, Pressure, Thrust, Buoyancy; Flow Kinematics; Integration of flow equations; Flow measurement; Relative motion; Moment of momentum; Viscosity, Boundary layer and Control, Drag, Lift; dimensional Analysis, Modeling; Cavitation; Flow oscillations; Momentum and Energy principles in Open channel flow, Flow controls, Hydraulic jump, Flow sections and properties; Normal flow, Gradually varied flow; Surges; Flow development and losses in pipe flows, Measurements; Siphons; Surges and Water hammer.

**(b) HYDRAULIC MACHINES AND HYDROPOWER:**

Centrifugal pumps, types, performance parameters, scaling, pumps in parallel; Reciprocating pumps, air vessels, performance parameters; Hydraulic ram;

Hydraulic turbines, types, performance parameters, controls, choice; Power house, classification and layout, storage, pondage, control of supply.

**2 (a) HYDROLOGY :**

Hydrological cycle, precipitation and related data analyses, PMP, unit and synthetic hydrographs; Evaporation and transpiration; Floods and their management, PMF; Streams and their gauging.

**(b) WATER RESOURCES ENGINEERING:**

Multipurpose uses of Water: Soil-Plant-Water relationships, irrigation systems, water demand assessment; Storages and their yields, ground water yield and well hydraulics; Water logging, drainage design; Irrigation revenue.

**3. ENVIRONMENTAL ENGINEERING**

**(a) WATER SUPPLY ENGINEERING:**

Sources of supply, yields, design of intakes and conductors; Estimation of demand; Water quality standards; Control of Water-borne diseases; Primary and secondary treatment, detailing and maintenance of treatment units; Conveyance and distribution systems of treated water, leakages and control; Rural water supply; Institutional and industrial water supply.

**(b) WASTE WATER ENGINEERING:**

Urban rain water disposal; Systems of sewage collection and disposal; Design of sewers and sewerage systems; pumping; Characteristics of sewage and its treatment, Disposal of products of sewage treatment, stream flow. Plumbing Systems, Rural and semi-urban sanitation.

**(c) SOLID WASTE MANAGEMENT:**

Sources, classification, collection and disposal; Design and Management of landfills.

**4(a) SOIL MECHANICS:**

Properties of soils, classification and interrelationship; Compaction behavior, methods of compaction and their choice; Permeability and seepage, flow nets, Inverted filters; Compressibility and consolidation; Shearing resistance, stresses and failure; soil testing in laboratory and in-situ; Stress path and applications; Earth pressure theories, stress distribution in soil; soil exploration, samplers, load tests, penetration tests.

**(b) FOUNDATION ENGINEERING:**

Types of foundations, Selection criteria, bearing capacity, settlement, laboratory and field tests, Types of piles and their design and layout, Foundations on expansive soils, swelling and its prevention, foundation on swelling soils.

**5.(a) SURVEYING:**

Classification of surveys, scales, accuracy, Measurements of distances-direct and indirect methods, optical and electronic devices, Measurement of directions, prismatic compass, local attraction, Theodolites-types, Measurement of elevations-spirit and trigonometric leveling, Relief representation, contours, Digital elevations modeling concept, Establishment of control by triangulations and traversing – measurements and adjustment of observations, computation of coordinates, Field astronomy, Concept of global positioning system.

**(b) TRANSPORTATION ENGINEERING:**

Planning of highway systems, alignment and geometric design, horizontal and vertical curves, grade separation, Materials and construction methods for different surfaces and maintenance, Principles of pavement design, Drainage.



**MECHANICAL ENGINEERING**

**PAPER — I**

**Total Marks - 200**

**Duration of Examination - 3 Hours**

**1. STRENGTH OF MATERIALS:**

Stress and strains in two dimensions, Principal stresses and strains, Mohr's construction, linear elastic materials, isotropy and anisotropy, stress-strain relations, uniaxial loading, thermal stresses. Beams: Bending moment and shear force diagram, bending stresses and deflection of beams, Shear stress distribution, Torsion of shafts, helical springs, Combined stresses, thick and thin walled pressure vessels. Struts and columns.

**2. Fluid Mechanics:**

Properties and classification of fluids, Manometer, forces on immersed surfaces, Centre of pressure, Bouyancy, Elements of stability of floating bodies. Kinematics and Dynamics. Irrotational and incompressible, Inviscid flow. Velocity potential, Pressure field and forces on immersed bodies. Bernoulli's equation, fully developed flow through pipes, pressure drops calculations, Measurement of flow rate and pressure drop. Integral approach, Laminar and turbulent flows, Separations. Flow over weirs and notches. Open channel flow, Hydraulic jump. Dimensionless numbers, Similitude and modelling.

**3. THEORY OF MACHINES:**

Cams, Gears and gear trains, Fly wheels, Governors. Balancing of rigid rotors and field balancing, Balancing of single and multicylinder engines. Critical speeds and whirling of shafts Automatic controls.

**4. MACHINE DESIGN:**

**Design of joints:** cotters, keys, splines, welded joints, threaded fasteners, joints formed by interference fits, Design of friction drives, couplings and clutches, belt and chain drives, power screws.

**Design of Power transmission systems:** gears and gear driveshaft and axle, wire ropes.

**Design of bearings:** hydrodynamics bearings and rolling element bearings.

**5. FLUID MACHINERY AND STEAM GENERATORS:**

Performance, Operation and control of hydraulic Pump, impulse and reaction Turbines, Specific speed, Classification, Energy transfer, Coupling, Power transmission, steam generators, Fire-tube and water-tube boilers, Flow of steam through Nozzles and Diffusers, Wetness and Condensation. Various types of steam and Gas turbines, Partial admission. Reciprocating, Centrifugal and axial flow, Compressors, Multistage compression, role of Mach Number, Reheat, Regeneration, Efficiency, Governance.

**MECHANICAL ENGINEERING  
PAPER — II**

**Total Marks - 200  
Duration of Examination - 3 Hours**

**1. THERMODYNAMICS:**

Cycles and IC Engines, Basic concepts, Open and Closed systems. Heat and Work. Zeroth, First and Second law, Application to non-flow and Flow processes, Entropy, Availability. Properties of ideal gases and vapours, Standard vapour, Gas power and Refrigeration cycles, Two stage compressors, CI and SI Engines, Pre-ignition, Detonation and Diesel knock, Fuel injection and Carburation, Supercharging. Turbo-prop and Rocket engines, Engine cooling, Emission & control. Measurement of Calorific values.

**2. HEAT TRANSFER, REFRIGERATION AND AIRCONDITIONING:**

Modes of heat transfer, One dimensional steady and unsteady conduction. Composite slab and Equivalent Resistance. Heat dissipation from extended surfaces. Heat exchangers, Overall heat transfer coefficient, Empirical correlations for heat transfer in laminar and turbulent flows and for free and forced Convection, Thermal boundary layer over a flat plate. Fundamentals of diffusive and convective mass transfer, Black body and basic Concepts in Radiation, Enclosure theory, Shape factor. Heat pump, and refrigeration cycles and systems, Refrigerants. Condensers, Evaporators and Expansion devices, Psychrometry, Charts and application to air conditioning, Sensible heating and cooling, Effective temperature, comfort indices, Load calculations, Solar refrigeration, controls, Duct design.

**3. ENGINEERING MATERIALS:**

Basic concepts on structure of solids. Crystalline materials. Defects in crystalline materials. Alloys and binary phase diagrams. Structure and properties of common engineering materials.

**4. INDUSTRIAL ENGINEERING:**

Production Planning and Control: Forecasting - Moving average, exponential smoothing, Operations, scheduling; assembly line balancing, Product development, Break-even analysis, Capacity planning, PERT and CPM. Control Operations: Inventory control ABC analysis, EOQ model, Materials requirement planning. Job design, Job standards, Work measurement

**ELECTRICAL ENGINEERING  
PAPER — I**

**Total Marks — 200  
Duration of Examination — 3 Hours**

**1. EM THEORY:**

Electric and magnetic fields. Gauss's Law and Amperes Law. Fields in dielectrics, conductors and magnetic materials. Time varying fields. Plane-Wave propagating in dielectric and conducting media. Transmission lines.

**2. ELECTRICAL MATERIALS:**

Conductors, Semi-conductors and Insulators. Super-conductivity. Insulators for electrical and electronic applications. Magnetic materials. Ferro and ferri magnetism. Ceramics, Properties and applications. Hall effect and its applications. Special semi conductors.

**3. ELECTRICAL CIRCUITS**

Circuits elements. Kirchhoff's Laws. Mesh and nodal analysis. Network Theorems and applications. Natural response and forced response. Transient response and steady state response for arbitrary inputs. Properties of networks in terms of poles and zeros. Transfer function. Resonant circuits. Three phase circuits. Two-port networks. Elements of two-element network synthesis.

**4. MEASUREMENTS AND INSTRUMENTATION**

Units and Standards. Measurement of current, Voltage, power, Power-factor and energy. Indicating instruments. Measurement of resistance, inductance, Capacitance and frequency. Bridge measurements. Electronic measuring instruments. Digital Voltmeter and frequency counter. Transducers and their applications to the measurement of non-electrical quantities like temperature, pressure, flow-rate displacement, acceleration, noise level etc. Data acquisition systems. A/D and D/A converters.

**5. CONTROL SYSTEMS.**

Block diagrams and signal flow graphs and their reduction. Errors for different type of inputs and stability criteria for feedback systems. Stability analysis using Routh-Hurwitz array, Nyquist plot and Bode plot. Root locus and Nicols chart and the estimation of gain and phase margin. Basic concepts of compensator design. State variable matrix and its use in system modelling and design. Sampled data system and performance of such a system with the samples in the error channel. Stability of sampled data system. Elements of non-linear control analysis. Control system components, electromechanical, hydraulic, pneumatic components.

**ELECTRICAL ENGINEERING  
PAPER II**

**Total Marks — 200  
Duration of Examination — 3 Hours**

**1. ELECTRICAL MACHINES AND POWER TRANSFORMERS.**

Magnetic Circuits. Construction and testing. Equivalent circuits. Losses and efficiency. Regulation. Auto-transformer, 3-phase transformer. Parallel operation.

Basic concepts in rotating machines. EMF, torque, basic machine types. Construction and operation, leakage losses and efficiency.

B.C. Machines. Construction, Excitation methods. Circuit models. Armature reaction and commutation. Generators and motors. Starting and speed control. Testing, Losses and efficiency.

Synchronous Machines. Construction. Circuit model. Operating characteristics. Synchronous reactance. Efficiency. Voltage regulation. Salient-pole machine, Parallel operation. Hunting. Short circuit transients.

Induction Machines. Construction. Principle of operation. Rotating fields. Characteristics and performance analysis. Determination of circuit model. Circle diagram. Starting and speed control. Fractional KW motors. Single-phase synchronous and induction motors.

## **2. POWER SYSTEMS**

Types of Power Stations, Hydro, Thermal and Nuclear Stations. Pumped storage plants. Economics and operating factors. Power transmission lines. Modeling and performance characteristics. Voltage control. Load flow studies. Optimal power system operation. Load frequency control. Symmetrical Components. Per Unit representation. Fault analysis. Transient and steady-state stability of power systems. Equal area criterion. Power system Transients. Power system Protection Circuit breakers. Relays. HVDC transmission.

## **3. ANALOG AND DIGITAL ELECTRONICS AND CIRCUITS**

Semi conductor device physics, PN junctions and transistors, circuit models and parameters, FET, Zener, tunnel, Schottky, photo diodes and their applications, rectifier circuits, voltage regulators and multipliers, switching behavior of diodes and transistors. Small signal amplifiers, biasing circuits, frequency response and improvement, multistage amplifiers and feed-back amplifiers, D.C. amplifiers, Oscillators. Large signal amplifiers, coupling methods, push pull amplifiers, operational amplifiers, wave shaping circuits. Multivibrators and flip-flops and their applications. Digital logic gate families, universal gates-combination circuits for arithmetic and logic operational, sequential logic circuits. Counters, registers, RAM and- ROMs.

## **4. MICROPROCESSORS**

Microprocessor architecture-Instruction set and simple assembly language programming. Interfacing for memory and I/O. Applications of Micro-processors in power system.

## **5. COMMUNICATION SYSTEMS**

Types of modulation; AM, FM and PM. Demodulators. Noise and bandwidth considerations. Digital communication systems. Pulse code modulation and demodulation. Elements of sound and vision broadcasting. Carrier communication. Frequency division and time division multiplexing, Telemetry system in power engineering.

## **6. POWER ELECTRONICS**

Power Semiconductor devices. Thyristor. Power transistor, GTOs and MOSFETS. Characteristics and operation. AC to DC Converters; 1-phase and 3-phase DC to DC Converters; AC regulators. Thyristor controlled reactors; switched capacitor networks. Inverters; single-phase and 3-phase. Pulse width modulation. Sinusoidal modulation with uniform sampling. Switched mode power supplies.

**SCHEDULE – V**

**Syllabus for Grade V (B) Junior Engineer (Diploma holder)**

**CIVIL ENGINEERING**

**PAPER — I**

**Total Marks — 200**

**Duration of Examination — 3 Hours**

**1. BUILDING MATERIALS & CONSTRUCTION:**

BRICKS AND TILE  
STONES, SAND  
CEMENT  
MORTAR  
CONCRETE  
TIMBER  
METALS AND OTHER ENGINEERING MATERIALS  
PAINTS AND VARNISHES  
BUILDING CONSTRUCTION  
CONSTRUCTION PLANNING AND STORAGE OF MATERIAL  
FOUNDATION  
BRICKS AND STONE MASONRY  
DAMP PROOFING  
LINTEL AND ARCHES  
ROOFS AND ROOF COVERINGS  
DOORS AND WINDOWS  
SCAFFOLDING  
STAIR AND STAIRCASES  
FLOORING  
WALL FINISH

**2. STRENGTH OF MATERIALS & THEORY OF STRUCTURE:**

STRENGTH OF MATERIALS  
BENDING MOMENT & SHEER FORCE IN BEAMS  
BENDING STRESS IN BEAMS  
SHEARING STRESSES IN BEAMS  
COLUMNS & STRUTS  
COMBINED BENDING & DIRECT STRESS  
COMPOUND & COMPLEX STRESS  
STRAIN ENERGY & IMPACT LOADING

**THEORY OF STRUCTURES**

DEFINITIONS & GENERAL PRINCIPLES  
PRIMARY STRESS ANALYSIS FOR STATICALLY DETERMINATE PIN JOINTED  
STRUCTURES.  
FIXED & CONTINUOUS BEAMS, PROPPED CANTILEVER  
MOMENT DISTRIBUTION METHOD  
RETAINING WALLS (EARTH RETAINING STRUCTURES)

**3. FOUNDATION ENGINEERING:**

GENERAL CONSIDERATIONS FOR DESIGN OF FOUNDATIONS  
TYPES OF FOUNDATION  
BEARING CAPACITY OF SOILS  
SETTLEMENT OF FOUNDATION  
PILE FOUNDATION  
SOIL STABILISATION  
SOIL EXPLORATION  
STRESS DISTRIBUTION IN SOILS  
EARTH PRESSURE

**4. CONCRETE TECHNOLOGY:**

MATERIALS FOR CEMENT CONCRETE  
PREPARATION OF CONCRETE  
CONCRETE MIX DESIGN  
QUALITY CONTROL  
SPECIAL CONCRETE  
DETERIORATION AND RESTORATION OF CONCRETE

**5. QUANTITY SURVEYING**

DEFINITION OF AN ESTIMATE AND TYPES  
SYMMETRICAL & UNSYMMETRICAL BOUNDARY WALL (USING MODULAR & TRADITIONAL BRICKS)  
CENTRE LINE, LONG WALL & SHORT WALL METHOD WITH EXAMPLE  
DEFINITION OF FLOOR AREA, CARPET AREA, PLINTH AREA, FAR  
ESTIMATE OF DIFFERENT ITEMS OF WORKS INVOLVED IN A SINGLE STOREY RESIDENTIAL BUILDING  
ESTIMATE OF R.C.C. BEAMS, CHUJIA, LINTEL AND SLAB (ONE WAY & TWO WAY REINFORCEMENT) SHOWING BAR BENDING SCHEDULE)  
CALCULATION OF QUANTITY OF MATERIALS OF DIFFERENT ITEMS OF WORKS  
CALCULATION OF VOLUME OF EARTH WORK OF DIFFERENT WORKS  
QUANTITY & COST ESTIMATE  
CONTRACTS  
PWD ACCOUNTS  
ARBITRATION  
VALUATION

**CIVIL ENGINEERING  
PAPER — II**

**Total Marks - 200  
Duration of Examination-3 Hours**

**1. HYDRAULICS**

INTRODUCTION  
FLUID STATIC  
FLUID FLOW  
FLUID MEASUREMENT FLOW THROUGH  
PIPES OPEN CHANNEL FLOW

**2. IRRIGATION**

HYDROLOGY  
WATER REQUIREMENT OF CROPS

CANAL IRRIGATION  
WELL IRRIGATION  
CANAL HEAD WORKS  
FLOOD CONTROL  
WATER LOGGING  
LAND RECLAMATION  
MAJOR IRRIGATION PROJECTS IN INDIA

**3. ENVIRONMENTAL ENGINEERING**

AIR POLLUTION  
AIR POLLUTION CONTROL MEASURES & EQUIPMENT  
METHODS & APPROACH OF AIR POLLUTION CONTROL  
DIFFERENT SOURCES OF WATER POLLUTION  
WATER POLLUTION & ITS CONTROL  
SOLID WASTE DISPOSAL

**4. SURVEYING**

LINEAR MEASUREMENTS  
CHAIN SURVEYING  
COMPASS SURVEYING  
LEVELLING  
CONTOURING  
THEODOLITE SURVEYING  
EARTH WORK CALCULATION  
PLANE TABLE SURVEYING  
COMPUTATION OF AREAS  
COMPUTATION OF VOLUME

**5. TRANSPORTATION ENGINEERING**

PROJECTS & PROFILES  
PERMANENT WAY  
TRACK GEOMETRICS  
POINTS & CROSSINGS  
STATIONS & YARDS  
PERMANENT WAY MAINTENANCE  
ROAD DRAINAGE  
TRAFFIC ENGINEERING HIGHWAY MAINTENANCE

**MECHANICAL ENGINEERING  
PAPER — I**

**Total Marks - 200  
Duration of Examination — 3 Hours**

**1. ENVIRONMENTAL ENGINEERING:**

AIR POLLUTION  
ANALYSIS OF AIR POLLUTANTS  
AIR POLLUTION CONTROL MEASURES & EQUIPMENT  
METHODS & APPROACH OF AIR POLLUTION CONTROL

**WATER & ENVIRONMENT**

WATER SOURCES

DIFFERENT SOURCES OF WATER POLLUTION

WATER POLLUTION & ITS CONTROL

NOISE & ENVIRONMENTAL MANAGEMENT SYSTEM

NOISE POLLUTION & CONTROL

ENVIRONMENTAL LEGISLATIONS, AUTHORITIES & SYSTEMS

**2. MECHANICS OF MATERIALS**

Stress and strain

Thin cylinder and spherical shells

Deflections of beams

Torsion of solid and hollow circular shafts

Springs

Riveted joints

**3. MACHINE TOOL**

GENERAL INTRODUCTION

METAL CUTTING

LATHE AND LATHE WORKS

DRILLING MACHINE

**BORING MACHINE SHAPER & PLANNER**

MILLING MACHINE GRINDING MACHINE

**4. FLUID MECHANICS**

PHYSICAL PROPERTIES OF FLUIDS

FLUID STATICS

FLUID KINEMATICS

FLUID MEASUREMENTS

IMPACT OF JET

PUMPS

HYDRAULIC TURBINE

**MECHANICAL ENGINEERING  
PAPER II**

**Total Marks - 200**

**Duration of Examination - 3 Hours**

**1. AUTOMOBILE ENGINEERING**

CONSTRUCTIONAL FEATURES

FUEL SUPPLY SYSTEM

COOLING SYSTEM

LUBRICATION SYSTEM

INTAKE & EXHAUST SYSTEM

FUELS

COMBUSTION IN ENGINE

AUTOMOBILE EMISSION & ITS CONTROL

ELECTRICAL SYSTEM

CHASSIS & BODY



TRANSMISSION SYSTEM  
GEAR BOX  
PROPELLER SHAFT & FINAL DRIVE  
SUSPENSION SYSTEM  
STEERING SYSTEM  
BRAKING SYSTEM  
WHEEL & TYRE  
GARAGE AND SERVICE STATION

**2. NON CONVENTIONAL ENERGY SOURCES**

SOLAR POWER PLANTS  
SOLAR ENERGY  
SOLAR RADIATION  
WIND POWER PLANTS  
WIND ENERGY  
ENERGY FROM BIO-MASS

**3. REFRIGERATION & AIR-CONDITIONING**

AIR REFRIGERATION SYSTEM  
VAPOUR COMPRESSION REFRIGERATION SYSTEM  
VAPOUR ABSORPTION SYSTEM  
REFRIGERANTS  
REFRIGERATION COMPONENTS, CONTROL AND SAFETY DEVICES  
APPLICATION OF REFRIGERATION

**ELECTRICAL ENGINEERING  
PAPER- I**

**Total Marks - 200  
Duration of Examination— 3 Hours**

**1. POWER PLANT ENGINEERING**

Conventional sources of Energy - Fossil fuels, Hydroelectric and nuclear.  
Thermal Power Station:  
Hydro-electric Power Stations:  
Nuclear Power Plants:  
Diesel Power Plant & Gas-turbine Plants:  
Elementary idea about Major Electrical Equipments used in Power Stations:  
Combined working of power plants  
Control of Active and Re-active power-Load-frequency control  
Performance of power \_stations and Economic considerations:

**2. ELECTRICAL DESIGN & ESTIMATING**

Design and Specification:  
Design of an electrical installation of machines in a workshop (Maximum 4 machines) [out of 4 machines at least 1 no. should be of 1-phase]  
I.E. rules related to Power Sub-circuit.  
Design of Electrical Machine:  
**Design of a 3-phase transformer up to 200 KVA: -**  
Estimation of a small residential complex.  
Estimation of lighting scheme of a large Auditorium and Public Health Centre,  
Estimation of electrical installation of machines (not more than four) in a .workshop  
Estimation for giving 3 - phase O.H. service connections to a residential building.

**3. ELECTRICAL MACHINES**

**GENERAL INTRODUCTION OF ROTATING MACHINE**

D.C. Machines:

D.C. Generator

D.C. Motors:

TRANSFORMERS

1-phase Transformers:

Principles of 1-phase Autotransformer

Three-phase transformer

Alternator

3-Phase Induction Motor

Synchronous Motor:

Fractional H.P. Motors:

**4. TRANSMISSION & DISTRIBUTION POWER**

Transmission System

Constructional Features of Transmission & Distribution Lines

Mechanical Features of Overhead lines

Spacing of conductors, length of span, Relevant I.E. Rules

Electrical features of Overhead lines

Power Factor Improvement

Using Static condenser and Synchronous condenser - related problems

Distribution System

Sub-stations

Extra High Voltage DC System of Transmission

**ELECTRICAL ENGINEERING  
PAPER— II**

**Total Marks - 200  
Duration of Examination-3 Hours**

**1. BASIC ELECTRONICS**

Passive & Active Circuit Elements

*Familiarity with the following components: —*

RESISTORS, FUSES, CAPACITORS, INDUCTOR,

Voltage source and current source

AC and DC signals, Transformer

RELAYS, SWITCHES, CABLES AND CONNECTORS

ZENER DIODE

BIPOLAR TRANSISTOR

FIELD EFFECT TRANSISTOR

UNIJUNCTION TRANSISTOR

THYRISTOR

OPTOELECTRONICS

INTEGRATED CIRCUITS

**2. ELECTRICAL MEASUREMENT & MEASURING INSTRUMENTS**

Definition & brief explanations of:

Range, sensitivity, true & indicated value, Errors (including limiting errors),

Resolutions, Accuracy, Precision and instrument efficiency.

Classification of instruments:

Basic Requirements for measurements:

Different types of instruments:

Voltmeter, ammeter, multimeter, energy-meter.

Multi-range ammeter and voltmeter

Methods of measuring diff. Electrical quantities

1-phase Induction type energy meter.

Errors adjustments

Phantom loading

Testing of energy meters.

Classifications of resistances

Description of Meggar.

Measurement of capacitance:

Magnetic measurements:

Instrument Transformers:

CT

PT or VT

Diff. Types of faults

### **3. CIRCUIT THEORY**

#### **NETWORKS & A.C. FUNDAMENTALS**

Single-phase A.C Circuits:

R-L-C Series Circuit:

Parallel Circuit:

#### **RESONANCE & SELECTIVITY**

SERIES RESONANCE

PARALLEL RESONANCE:

#### **TRANSIENTS (FOR ELECTRICAL ENGINEERING ONLY)**

Steady State & Transient Response.

POLYPHASE CIRCUITS:

COUPLED CIRCUITS:

LAPLACE TRANSFORMATIONS:

FILTERS:

LAPLACE TRANSFORMATIONS

### **4. ELECTRICAL MEASUREMENT & CONTROL**

Measurement of Power/Energy & Industrial Metering:

Digital energy-meter

Operation & Utility of Tri-vector meter.

Digital frequency meter

(i) Mech. Resonance type (ii) Electrical resonance type Frequency meter Power manager.

Synchroscope:

Phase-sequence meter

Digital multimeter

C.R.O.—block diagram representation & operation, applications

Use of dual trace oscilloscope.

Function generator

Frequency Counter—

Elements of Servomechanism:

Super Motor—

**Measurement of Non-electrical quantities:**

**Study of the following transducers:**

Piezo-electric crystal.  
Thermistor.  
Strain gauge.  
Proximity switch.  
Thermocouple.  
LVDT.  
Tachogenerator (a.c. & d.c.)  
Capacitive transducers  
Seismic transducers.

**CONTROL SYSTEM:**

**Brief descriptions with physical example (along with schematic diagram) of:**

On-off controller.  
Proportional controller.  
Proportional plus derivative controller.  
P+I controller.  
P + D + I controller.

**5. ELECTRICAL INSTALLATION, MAINTENANCE AND TESTING**

General guidelines for Installation:

Loading & unloading of heavy electrical m/c:

Electrical Installation requirements:

Earthing Installation:

General requirement of electric installation according to I.E. Rules:

Motor generator set for battery charging and to supply various loads.

Synchronization of two alternators.

Maintenance of electrical installations

Insulations

Troubleshooting

Repair & maintenance with maintenance Schedule of

D.C. machine

Transformer

Induction motor

Switchgear & Substation:

Relays

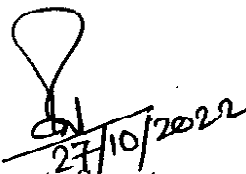
Brief account of maintenance of contractors

Storage Batteries

OH lines and Cables

Testing

Electric Safety Regulations

  
27/10/2022  
Deputy Secretary  
Public Works Department